



Analysis of characteristics affecting instrumental activities of daily living in Parkinson's disease patients without dementia

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Abstract

Patients with Parkinson's disease (PD) are liable to experience impairment in their activities of daily living (ADL), which include ambulating, eating, dressing, bathing, and personal hygiene. The aim of this study is to assess which clinical characteristics contribute significantly to instrumental ADL (IADL) in PD patients without dementia. We included 106 PD patients in our study, and each patient's motor and non-motor status and basic and instrumental ADL were assessed using the appropriate scales. Of the 106 PD patients, 31 (29.2%) had abnormal Korean IADL (K-IADL) scores. These patients were older and had higher scores in terms of the modified Hoehn and Yahr (mHY) staging scale, Unified Parkinson's Disease Rating Scale (UPDRS) parts II and III, UPDRS part IV motor fluctuation, Beck Depression Inventory (BDI), and total Non-Motor Symptoms assessment scale for PD (NMSS), as well as lower scores in the Mini-Mental State Examination (MMSE). Pearson's correlation analysis showed significant associations between the scores of K-IADL and each of the following characteristics of the patients: age, mHY stage, UPDRS parts II and III, UPDRS part IV motor fluctuation, BDI, total NMSS, and MMSE. Multivariate linear regression analysis showed that the significant clinical characteristics associated with the K-IADL scores were determined to be the UPDRS part II, MMSE, and BDI scores. The results of our study revealed that the cognitive, depression, and motor symptoms were the significant predictors of IADL in PD patients without dementia.

Keywords Parkinson's disease · Activities of daily living · Cognition · Depression

Introduction

Parkinson's disease (PD) is characterized by a combination of motor and non-motor symptoms [1]. Patients with PD are liable to experience impairment in their activities of daily living (ADL), which include ambulating, eating, dressing, bathing, and personal hygiene [2], since both the motor and non-motor symptoms affect ADL in these patients [3]. The relative importance of these symptoms in PD patients with respect to its impact on ADL, however, remains uncertain. Scales for ADL might be insensitive when assessing PD dementia (PDD) patients, as the scale may not distinguish between whether ADL impairment is due to a motor or non-motor deficit.

ADL impairment is required for the diagnosis of dementia, and ADL can be classified into basic and instrumental activities, based on their difficulty and complexity in the levels of functioning [4]. Instrumental ADL (IADL) are more complex and demanding in terms of cognitive control, and therefore more sensitive to cognitive decline [4]. IADL impairment is also more prevalent than its basic counterpart at the onset of dementia [5].

Cognitive impairment and dementia are commonly associated with PD. The prevalence of PDD is approximately 30%, and its incidence is increased by four to six times than that of the general population [6]. For the diagnosis of PDD, ADL deficits that are independent of the impairment associated with motor or autonomic symptoms are essential [7]. However, there is no consensus on scales available for the assessment of the ADL associated with cognitive impairment in PDD patients, who are typically in an advanced stage, and therefore are likely to already have impairment in both basic and instrumental ADL [8]. There are some studies that have focused on the ADL of PD patients [4, 8–10]; however, those studies have certain limitations in that they primarily target the ADL

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associated with motor symptoms or are primarily targeted towards dementia patients only.

For the early diagnosis of dementia in PD patients, it is important to assess IADL associated with cognitive dysfunction in PD patients without dementia. However, to the extent of our knowledge, there are no studies that have focused on impairment of IADL in such PD patients. Therefore, the aim of this study is to assess which clinical characteristics contribute significantly to IADL in PD patients without dementia.

Patients and methods

Subjects

The study population included 106 PD patients who were admitted to the Movement Disorders Clinic at Chonnam National University Hospital, South Korea. The patients were diagnosed with PD according to the UK Parkinson's Disease Society Brain Bank clinical diagnostic criteria [1], with the diagnoses being confirmed by a movement disorder specialist (SM Choi) at the last hospital visit. In terms of inclusion criteria, all PD patients had a positive response to levodopa and had no clinically significant lesions on brain magnetic resonance imaging; other inclusion criteria included patients having normal basic ADL and their caregivers being available to provide ancillary history, while the exclusion criteria included patients with atypical or secondary parkinsonism, neurological diseases other than PD, dementia, severe co-morbidities that interfere with daily functioning, deep brain stimulation surgery, and an inability to complete clinical assessments.

All participants in the study provided written consent for their participation. This study was approved by the Institutional Review Board of the Chonnam National University Hospital and conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

Clinical evaluation

Patients and their caregivers were initially interviewed and examined by neurologists (GJ Yoon and HJ Jung) who were pre-trained for the interview. The clinical evaluations were completed by the neurologists during the patients' last hospital visits, and any missing historical data was retrieved from the relevant hospital charts. The patients were examined in the "on" or best condition. They were asked about the age of symptom onset, disease duration, and any past and current medications. The levodopa equivalent dose (LED) of all medications taken at the time of the interview for each patient was also calculated [11]. The patient's weight and height were measured in the standing position, and body mass index (BMI) was then calculated as the weight in kilograms divided

by the square of the height in meters. The parkinsonism motor states of the patients were assessed using the modified Hoehn and Yahr (mHY) staging scale [12], and the Unified Parkinson's Disease Rating Scale (UPDRS) [2], while the non-motor symptoms of the patients were assessed using the Korean version of the Mini-Mental State Examination (MMSE) [13], Beck Depression Inventory (BDI) [14], and Non-Motor Symptoms assessment scale for PD (NMSS) [15].

Basic and instrumental ADL were also assessed using the Barthel-ADL and the Korean IADL (K-IADL) scales, respectively [16]. As per previous studies, the K-IADL scale was found to be a reliable and valid tool for the quantification of functional disability in dementia patients [16, 17]; the scale itself is composed of 11 items, including shopping, mode of transportation, ability to handle finances, housekeeping, food preparation, ability to use a telephone, responsibility for own medication, recent memory, hobbies, watching television, and house maintenance. Each item is rated as 0 (normal), 1 (with some assistance), 2 (with much assistance), 3 (unable to do), and NA (not applicable). The cut-off point, which distinguishes dementia patients from the respective normal control, was previously determined to be 0.43 [16], and therefore, we used the same cut-off point to define abnormal K-IADL.

Statistical analysis

SPSS, version 20.0 for Windows (IBM Corp.; Armonk, NY, USA), was used to perform all statistical analyses. Independent sample Student's *t* test for continuous variables and χ^2 test for categorical variables were used to determine the significance of any differences in the clinical characteristics between the PD patients with normal and abnormal K-IADL. Pearson's correlation analysis was used to determine potential clinical characteristics associated with K-IADL. Statistically significant characteristics in the aforementioned analyses were subsequently included as dependent variables in the multivariate linear regression model analysis with K-IADL. Lastly, Pearson's correlation analysis was also used to determine the relationship between each item of the K-IADL and the significant clinical characteristics. Data with a $p < 0.05$ was considered statistically significant.

Results

The clinical characteristics of the PD patients in the study are shown in Table 1. Of the 106 PD patients, 31 (29.2%) had abnormal K-IADL scores. These PD patients were older and had higher scores in terms of the mHY staging scale, UPDRS parts II and III, UPDRS part IV motor fluctuation, BDI, and total NMSS, as well as lower scores in MMSE. There were no significant differences in sex, age of PD symptom onset, disease duration,

Table 1 Differences in clinical characteristics of Parkinson's disease patients with normal and abnormal instrumental activities of daily living

Characteristics	All patients (n = 106)	Normal K-IADL* (n = 75)	Abnormal K-IADL* (n = 31)	p value
Demographic and clinical				
Age (years)	67.8 ± 7.3	66.9 ± 6.9	70.7 ± 7.7	0.036
Sex (female:male)	65:41	43:32	22:9	0.148
Age of PD symptom onset (years)	62.0 ± 8.0	61.4 ± 7.6	63.8 ± 9.2	0.250
Disease duration (years)	5.8 ± 3.1	5.4 ± 2.9	6.9 ± 3.5	0.057
BMI	32.3 ± 23.1	22.9 ± 3.9	23.5 ± 2.9	0.529
Levodopa equivalent dose (mg)	416.0 ± 166.1	397.8 ± 167.7	472.5 ± 151.2	0.073
Motor				
mHY stage	1.9 ± 0.5	1.8 ± 0.5	2.3 ± 0.6	0.001
UPDRS part II score	8.4 ± 5.0	7.6 ± 4.8	11.1 ± 4.5	0.004
UPDRS part III score	20.5 ± 8.7	19.2 ± 8.8	24.7 ± 7.0	0.010
UPDRS part IV dyskinesia	0.4 ± 0.7	0.3 ± 0.7	0.6 ± 0.8	0.157
UPDRS part IV motor fluctuation	1.0 ± 0.8	0.9 ± 0.7	1.3 ± 0.8	0.029
Non-motor				
MMSE score	25.5 ± 4.1	26.1 ± 3.9	23.9 ± 4.3	0.017
BDI score	11.8 ± 8.9	9.3 ± 7.0	20.1 ± 9.4	< 0.001
Total NMSS score	58.6 ± 37.8	48.5 ± 31.3	89.8 ± 39.5	< 0.001

Values presented as mean ± standard deviation

*Cut-off point is 0.43

K-IADL Korean Instrumental Activities of Daily Living, *PD* Parkinson's disease, *BMI* body mass index, *mHY stage* modified Hoehn and Yahr stage, *UPDRS* Unified Parkinson's Disease Rating Scale, *MMSE*, Mini-Mental State Examination, *BDI* Beck Depression Inventory, *NMSS* Non-Motor Symptoms assessment scale for Parkinson's disease

BMI, LED, and UPDRS part IV dyskinesia scores between those PD patients with normal and abnormal K-IADL.

Pearson's correlation analysis was also performed to determine the relationship between K-IADL scores and clinical characteristics in the PD patients. Statistically significant associations were found between the scores of K-IADL and either of the following characteristics: age, mHY stage, UPDRS parts II and III, UPDRS part IV motor fluctuation, BDI, total NMSS, and MMSE, as shown in Table 2. Multivariate linear regression analysis was then performed to determine the significant clinical characteristics associated with the K-IADL scores; these significant characteristics were determined to be the UPDRS part II, MMSE, and BDI scores, as shown in Table 3.

Finally, the relationships between each item of K-IADL and UPDRS part II, MMSE, or BDI are shown in Table 4. The UPDRS part II and BDI scores were associated with the K-IADL scores in similar items such as shopping, housekeeping, food preparation, hobbies, watching television, and house maintenance, whereas the MMSE score was associated with the K-IADL scores in items such as shopping, mode of transportation, ability to handle finances, ability to use a telephone, and responsibility for own medications.

Discussion

In this cross-sectional study on the characteristics affecting IADL in PD patients without dementia, it was observed that the PD patients with abnormal K-IADL had poorer motor and non-motor scores than those with normal K-IADL. Similar associations between the scores of K-IADL and clinical characteristics, such as age, mHY stage, UPDRS parts II and III, UPDRS IV motor fluctuation, BDI, total NMSS, and MMSE were also observed in the correlation analysis. In multivariate analysis, UPDRS part II, MMSE, and BDI scores were determined to be the significant predictors of IADL in the PD patients.

The assessment of the ADL in PD patients is essential for evaluating both the patient's condition and the effectiveness of treatments. The UPDRS is a widely used clinical tool that assesses the mentation, ADL, motor symptoms, and treatment complications in PD patients [2]. The UPDRS part II score is a good marker of PD progression [9]; however, most of its items are associated with the motor symptoms of PD. Motor dysfunction has the strongest negative influence on the ADL in PD patients [3, 10] and is the major contributor to IADL impairment in PDD patients [10]. These findings are consistent with our

Table 2 Relationship between the instrumental activities of daily living and clinical characteristics in Parkinson's disease patients

Characteristics	K-IADL	
	Pearson correlation	<i>p</i> value
Demographic and clinical		
Age (years)	0.229	0.034
Sex (female:male)	0.155	0.155
Age of PD symptom onset (years)	0.149	0.172
Disease duration (years)	0.151	0.165
BMI	−0.026	0.813
Levodopa equivalent dose (mg)	0.184	0.090
Motor		
mHY stage	0.279	0.009
UPDRS part II score	0.376	<0.001
UPDRS part III score	0.263	0.014
UPDRS part IV dyskinesia	0.116	0.295
UPDRS part IV motor fluctuation	0.238	0.030
Non-motor		
MMSE score	−0.253	0.020
BDI score	0.487	<0.001
Total NMSS score	0.446	<0.001

K-IADL Korean Instrumental Activities of Daily Living, *PD* Parkinson's disease, *BMI* body mass index, *mHY stage* modified Hoehn and Yahr stage, *UPDRS* Unified Parkinson's Disease Rating Scale, *MMSE* Mini-Mental State Examination, *BDI* Beck Depression Inventory, *NMSS* Non-Motor Symptoms assessment scale for Parkinson's disease

results that show the associations of the IADL scores with mHY stage and UPDRS parts II and III scores [10]. However, in this study, only the UPDRS part II score was significantly related to IADL score in multivariate analysis.

Table 3 Multivariate linear regression analysis to determine the significant clinical characteristics associated with instrumental activities of daily living in Parkinson's disease patients

Characteristics	K-IADL	
	Beta	<i>p</i> value
Age (years)	0.120	0.226
mHY stage	0.152	0.131
UPDRS part II score	0.227	0.030
UPDRS part III score	0.096	0.373
UPDRS part IV motor fluctuation	0.120	0.206
MMSE score	−0.263	0.006
BDI score	0.406	<0.001
Total NMSS score	0.136	0.210

K-IADL Korean Instrumental Activities of Daily Living, *mHY stage* modified Hoehn and Yahr stage, *UPDRS* Unified Parkinson's Disease Rating Scale, *MMSE* Mini-Mental State Examination, *BDI* Beck Depression Inventory, *NMSS* Non-Motor Symptoms assessment scale for Parkinson's disease

Along with the motor symptoms, non-motor symptoms also affect the ADL in PD patients, with sleepiness, memory complaints, and hallucinations all exerting a negative influence on it [3]. Additionally, cognitive states and depression have also been reported to affect ADL [18, 19]. Consistent with those reports, the MMSE and BDI scores were significant characteristics determining IADL in this study. Therefore, cognition and depression might be significant predictors of IADL in PD patients.

Functional disability is a defining feature observed in all forms of dementia, and a decline in the ADL is one of its most troublesome aspects [5]. In Alzheimer's disease, these problems typically appear when conducting IADL, and eventually progresses to a point that the affected person is unable to manage even basic ADL [5]. Cognitive dysfunction is also associated with ADL impairment in PD, and additionally, ADL deficits due to cognitive impairment are considered to be essential for the diagnosis of PDD [7]. In some studies, the PDD group reported significantly poorer scores in basic ADL compared with the PD group [8], with the total IADL score lower in PDD patients than that of PD patients, and overall, the PD group performed better than the PDD group on most items [8]. Similar to those results, the MMSE score was a significant predictor of IADL in this study, especially with respect to certain items such as shopping, transportation, financial handling, telephone use, and medicine consumption. Therefore, it might be important to investigate these items for assessing the cognitive function-related IADL deficits in PD patients without dementia.

Depression and IADL have been known to exhibit a bidirectional relationship in previous studies [20, 21]. Depression is one of the predictors of impairment in both basic and instrumental ADL [21], and IADL is a significant determinant of high rates of depression in elderly people [20]. Correspondingly, depression was also determined to be a significant characteristic of IADL in this study, especially with respect to items such as shopping, financial handling, housekeeping, food preparation, recent memory, hobbies, watching television, and house maintenance. The IADL items associated with depression were similar to those associated with UPDRS part II but simultaneously different from those associated with cognitive dysfunction. Further comprehensive studies are required in order to identify the IADL items that are mainly affected by either cognitive dysfunction or depression without being influenced by the motor symptoms of PD.

This study has several limitations. First, there are potential unmeasured confounders that could affect IADL in PD patients that were not considered here. Second, detailed neuropsychological tests were not conducted as a part of this study. Third, this study was cross-sectional; thus, the associations observed herein cannot be construed as definitive evidence of causal associations.

In conclusion, the scores of UPDRS part II, MMSE, and BDI were determined to be the significant predictors of IADL

Table 4 Relationships between each item of instrumental activities of daily living and UPDRS part II, MMSE, or BDI

K-IADL	UPDRS part II	MMSE	BDI
1. Shopping	0.223 (0.044)	−0.342 (0.002)	0.295 (0.008)
2. Mode of transportation	0.130 (0.237)	−0.309 (0.005)	0.135 (0.226)
3. Ability to handle finances	0.168 (0.132)	−0.297 (0.007)	0.338 (0.002)
4. Housekeeping	0.313 (0.004)	−0.150 (0.185)	0.327 (0.003)
5. Food preparation	0.371 (0.002)	−0.094 (0.448)	0.402 (0.001)
6. Ability to use telephone	0.110 (0.323)	−0.270 (0.015)	0.193 (0.084)
7. Responsibility for own medications	0.037 (0.737)	−0.310 (0.004)	0.200 (0.071)
8. Recent memory	0.168 (0.123)	−0.098 (0.379)	0.278 (0.011)
9. Hobby	0.432 (<0.001)	−0.014 (0.990)	0.343 (0.002)
10. Watching television	0.327 (0.002)	−0.126 (0.257)	0.473 (<0.001)
11. House maintenance	0.473 (<0.001)	−0.136 (0.265)	0.451 (<0.001)

Values presented as correlation coefficient (*p* value)

K-IADL Korean Instrumental Activities of Daily Living, *UPDRS* Unified Parkinson's Disease Rating Scale, *MMSE*, Mini-Mental State Examination, *BDI* Beck Depression Inventory

in PD patients without dementia. Therefore, clinicians should consider the cognitive, depression, and motor symptoms for the proper evaluation of IADL in such PD patients. Further studies are required to completely assess the roles of those characteristics affecting IADL in PD patients.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by the Institutional Review Board of the hospital, and informed consent was obtained from the study participants.

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